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BASELINE DEFINITION OF
PACKET RADIO NETWORK
Revision 0

1.0 GENERAL DESCRIPTION

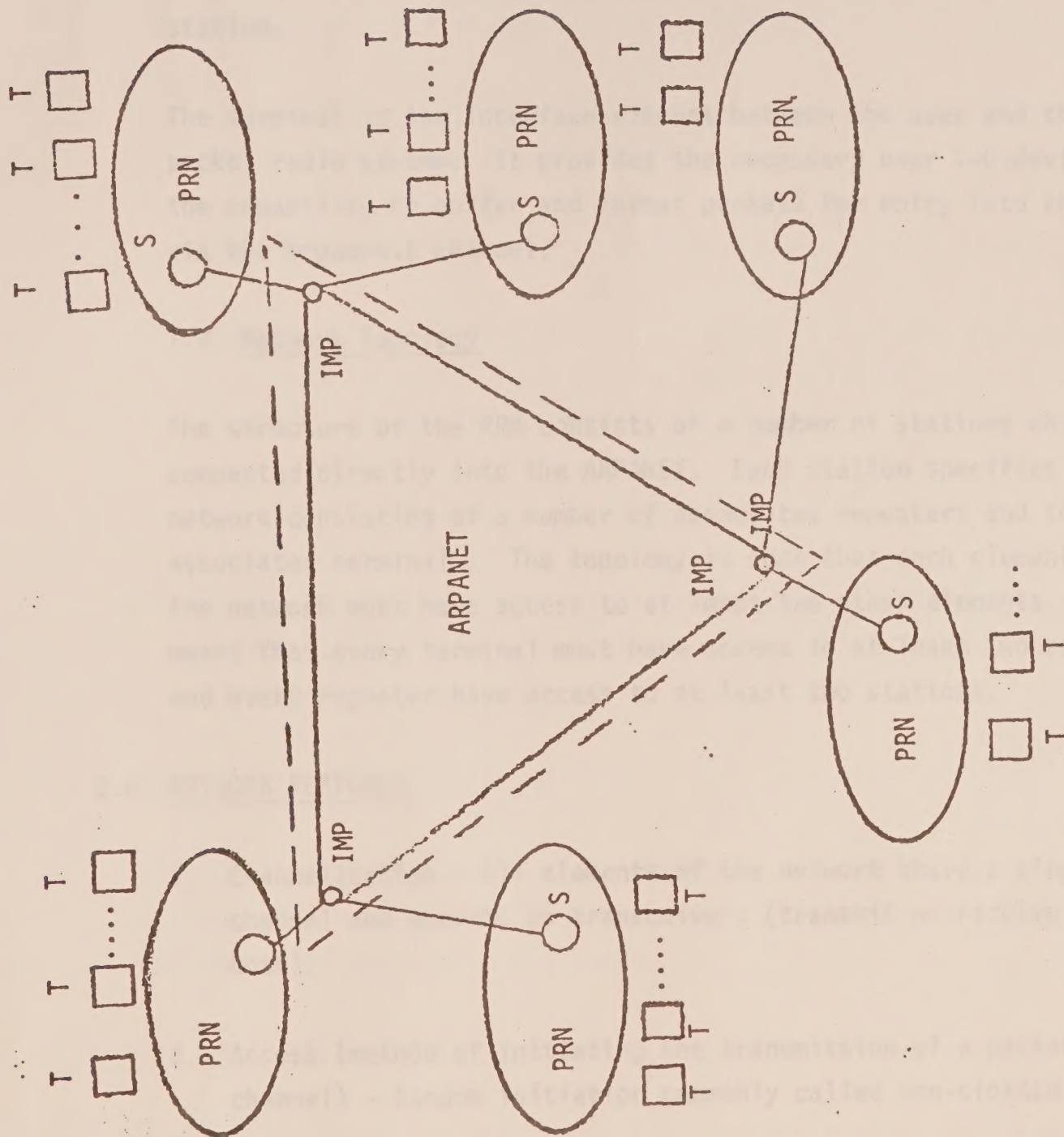
1.1 Purpose of Network

The purpose of the packet radio system is to provide a broadcast extension to the link base ARPA computer network, so that additional terminals can be added to the ARPA Network without need of hardwire connections. Figure 1 shows the packet radio network and its relation to the ARPA computer network. The task of the packet radio network is to transfer packets between remote or mobile terminals and the ARPA computer network.

1.2 Network Elements

There are three functional elements in the packet radio network (PRN). They are; stations, repeaters, and terminals.

A station is the interface element between the PRN and the ARPANET. The station has a number of repeaters and terminals associated with it. The station has a broadcast access to the repeaters and terminals and a link channel into the ARPANET. The stations perform accounting, buffering, directory and routing functions for the network of associated repeaters and terminals.



S - Station
T - Terminal

Figure 1 - Combined ARPANET And Packet Radio Network System



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The function of the repeater element is to extend the effective range of the terminals and stations. The repeater therefore performs one basic function of receiving and transmitting packets in the PRN. The repeater has access to the broadcast channel to receive and transmit packets. It additionally has the function of detecting errors in packets as well as routing packets under the direction of the station.

The terminal is the interface element between the user and the total packet radio system. It provides the necessary user I-O devices and the capability to buffer and format packets for entry into the system via the broadcast channel.

1.3 Network Topology

The structure of the PRN consists of a number of stations which are connected directly into the ARPANET. Each station specifies a sub-network consisting of a number of associated repeaters and their associated terminals. The topology is such that each element of the network must have access to at least two other elements. This means that every terminal must have access to at least two repeaters and every repeater have access to at least two stations.

2.0 NETWORK FEATURES

1. Channelization - All elements of the network share a single common channel and operate as transceivers (transmit or receive, but not both).
2. Access (method of initiating the transmission of a packet on the channel) - Random initiation commonly called non-slotted Aloha.
3. Packet Routing - All packets from terminals go through the station. Packets will transfer through the network on a "minimum path" route which is assigned by the station.

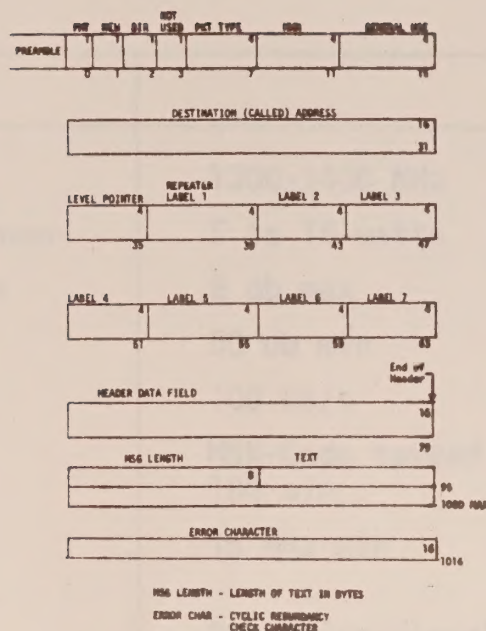
4. Acknowledgment - Packet transfers of end devices to repeaters and repeaters to repeaters are acknowledged through a passive echo mode. Packet transfers of repeaters to end devices are acknowledged through active special packet mode. Random re-transmission of a packet continues until packet is acknowledged.
5. Channel Information Rate - 100K bits/sec.
6. Packet Size - Variable length with maximum length of 1000 bits and minimum length of 80 bits (fixed length header only).
7. Packet Organization - Refer to Figure 2 for packet format.
8. Communication Security Method - A state-of-the-art non-linear, multi-key variable cryptographic device which is remotely re-keyable. Header and text are both encrypted.
9. R.F. Carrier Assignment - 1300-1400 MHz.
10. Modulation Method - Minimum shift key code spread of the order of 100 [each bit of information encoded into 100 chip long pseudo-random sequence].

3.0 REPEATER BASELINE DEFINITION

The baseline definition of the repeater is divided into three categories. These are; R.F. Characteristics, Logical Process Characteristics and Physical Constraints.

3.1 R.F. Characteristics

The definition of the repeater's R.F. characteristics are given in Table 1.



FMT:	0 - HDR	REPEATER LABEL:	NETWORK ASSIGNED
	1 - HDR & TEXT		ROUTING ADDRESS
NEW:	1 - 1st TX OF PKT		WITHIN A LEVEL.
	0 - RE TX		1111 - "ALL" BROADCAST
DIRECTION:	0 - FROM STATION		MODE
	1 - TO STATION		
PKT TYPE:	0000 MSG STA - RPTR/TERM	HEADER DATA FIELD	FOR ENCODED CONTROL
	0001 STATUS		MSGS - TO BE ASSIGNED -
	0010 CONTROL STA - RPTR/TERM		AND TEXT INFO
	0011 SEARCH		
	0100 RESPONSE TO SEARCH		
	0101 CONTROL LABELING		
	0110		
	0111 ACK		
MHN:	NO. OF LEVELS AWAY FROM		
	DESTINATION ADDRESS		
GENUSE:	AVAILABLE FOR VARIOUS INFO.		
DESTINATION ADDR:	TO STA - STATION (CAN OMIT)		
	FROM STA - NETWORK ASSIGNED ID OF		
	REPEATER OR TERMINAL		
LEVEL POINTER:	0000 - STATION LEVEL		
	0001 - 1 HOP OUT FROM STA		
	0010 - 2 HOPS OUT FROM STA		
(MAX)	0111 - 7 HOPS OUT FROM STA		

FIGURE 2 - PACKET FORMAT

Specification	
Carrier Frequency	1300-1400 MHz
Effective Radiated Power	5 to 15 watts
Receiver Noise Figure	6 db max
Dynamic Range	50 db min
Bit Rate	100 kb/s
Modulation Method	MSK-Code spread of 100 min
Necessary Bandwidth Requirement	15 MHz min
Antenna Type	Omni directional in the azimuth plane with vertical polarization

TABLE 1

3.2 Logical Process Characteristics

The logical process characteristics refers to the responsibilities of the repeater in regard to the network operating discipline (routing, acknowledgment, etc.).

3.2.1 Routing

The repeater must store a minimum path to its station and have the ability to determine if it is a member of the minimum path route of a packet. It must check the packet for errors and, if correct, send the packet along on its designated path.

3.2.2 Access

The repeater will operate on only one packet at a time and not accept new packets for repeating until the packet it presently holds is acknowledged by the following element in the packet's path.

3.2.3 Acknowledgment

The repeater will have the ability to repeatedly retransmit a packet if it is not acknowledged after a random length of time. This requires that the repeater check the headers of received packets to determine if the packet it is transmitting has been received correctly and retransmitted.

3.3 Physical Constraints

The physical constraints of the repeater are given in Table 2.

Specification	
Volume (without energy source)	3.0 ft ³ max
Weight (without energy source)	man portable
Energy Source Requirements	
Peak Power Drain	50 watts
Average Power	10 watts
100% Duty Cycle Time of Operation	2 months
Weight	100 lbs.

TABLE 2

The repeater has self-contained energy source and is contained in rugged all-weather housing.

4.0 TERMINAL BASELINE DEFINITION

The baseline definition of the terminal is divided into four segments. These are; R.F. Characteristics, Logical Process Characteristics, Input-Output Characteristics and Physical Constraints.

4.1 R.F. Characteristics

The definition of the terminal's R.F. characteristics are given in Table 3.

Specification	
Carrier Frequency	1300-1400 MHz
Effective Radiated Power	5 watts min
Receiver Noise Figure	6 db max
Dynamic Range	50 db min
Bit Rate	100 kb/s
Modulation Method	MSK code spread of 100 min
Bandwidth Requirement	15 MHz min
Antenna Type	Omni directional in the azimuth plane with vertical polarization

TABLE 3

4.2 Logical Process Characteristics

The logical process responsibilities of the terminal are; 1) determine when receive packets are addressed to it, 2) acknowledge received packets from adjacent repeaters, 3) continue to transmit packets after random periods until an acknowledgment is received.

The terminal will convert and store information from input devices until information fills the maximum packet size or information ends, at which time the terminal will transmit this information in packet form. The terminal will convert packets received into output device format and input to respective output device at the required rate.

4.3 Physical Constraints

The physical constraints of the terminal are given in Table 4.

Specification	
Volume (without energy source)	.5 ft ³ max
Weight (without energy source)	man portable
Energy Source Requirements	
Peak Power Drain	20 watts
Average Power	5 watts
100% Duty Cycle Time of Operation	5 hours
Weight	1 lb.

TABLE 4

5.0 STATION BASELINE DEFINITION

The definition of the station is divided into two segments. These are; R.F. Characteristics and Logical Process Characteristics.

The R.F. characteristics of the station are similar to the repeater's R.F. requirements and, therefore, Table 1 is referred to for the station's R.F. characteristics. The logical process characteristics of the station include the addressing of all elements within its domain, defining minimum paths for all of its repeaters, buffering of packets and conversion of PRN packets into ARPA computer network format. Other characteristics of the station are yet to be defined.

